Transcatheter closure of patent ductus arteriosus with the Inoue single-branched stent graft

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Patent ductus arteriosus (PDA) is usually found in early childhood. Delayed clinical presentation of PDA in adults is rare. Open surgical treatment of PDA in adults is technically more difficult than in children. Transcatheter closure of the ductus in adults has become an attractive alternative to surgery.[1,2] Gianturco coils have been proven to be effective in closing ductus of small to moderate size. However, coil closure frequently relates residual shunts in large ducts with a diameter more than 5 mm.[1] Amplatzer duct occluder (ADO) has recently been reported to be safe and effective for closure of large ductus.[2] However, the Ministry of Health, Labour and Welfare in Japan has not approved the use of ADO in Japan. In this report, successful closure of a large ductus by using the Inoue single-branched stent graft is presented.

Clinical Summary

A 73-year-woman was referred to our institution. Her original presentation had been with exertional dyspnea. Physical examination revealed a continuous murmur on auscultation. Left ventricular hypertrophy with a strain pattern was apparent on 12-lead electrocardiogram. Chest radiograph documented cardiomegaly with increased pulmonary vascular markings. Assessment with transthoracic echocardiography revealed left ventricular volume overload and a continuous flow in the pulmonary trunk that suggested the presence of a large PDA. The maximum diameter of the PDA was 7 mm, and the length was 6 mm in a contrast-enhanced computed tomographic scan (Figure 1). Routine right and left heart catheterization was performed; the pulmonary/systemic flow ratio was 3.5. The PDA was considered too large to treat with coil embolization, and the patient rejected open surgical repair. The decision was made to close the PDA by using the Inoue stent graft.

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The endovascular Inoue stent-grafting system and its implantation techniques have been described in detail.[3] The PDA was located at the minor curvature of the distal aortic arch near the left subclavian artery. The single-branched stent graft was required. The Inoue stent graft was custom-made for the patient; the diameter of the designed stent graft was 36 mm in the proximal neck, 32 mm in the distal neck, and 12 mm in the branch. With the patient under local anesthesia, the right femoral artery was surgically isolated, and a transverse arteriotomy was performed. A 22F introducer sheath was inserted thorough the right femoral artery, and a 7F sheath was inserted in the left brachial artery. The folded stent graft was advanced to the descending thoracic aorta and then released from the introducer sheath. After the stent graft was properly positioned, it was unfolded. The graft was then dilated by balloon inflation. Aortograms confirmed that the stent graft was properly positioned and that the ductus was completely occluded. Oxygen measurements did not reveal a step-up in saturation in the pulmonary artery after the stent grafting. The procedure time was 150 minutes, and 350 mL of contrast media was used. A computed tomographic scan at 1 week after surgery demonstrated satisfactory graft position and complete closure of the PDA (Figure 2). The postoperative course was uneventful, and the patient's exertional dyspnea was diminished after the procedure.

Discussion

Transcatheter closure of PDA has been shown to be safe and effective.[1,2] The most common approaches are multiple coil implantations or the ADO. The ADO devices can be applied to moderate to large PDAs up to 11 mm.[2] However, some articles have reported larger PDAs (>20 mm).[4] The stent grafting can be applicable regardless of the size of the PDA.

Although stent grafting requires a sufficient proximal landing zone, the PDA usually locates near the left subclavian artery. Management of the left subclavian artery is required. Surgical transposition of the left subclavian artery before the stent-graft placement is the traditional option. Several articles have recently demonstrated the safety of the intentional coverage of the left subclavian artery without prophylactic surgical transposition.[5] However, subclavian steal syndrome developed in some patients and necessitated revascularization of the left subclavian artery during follow-up.

Ozmen and colleagues[6] have reported a case of stent grafting for a PDA. They crossed the left subclavian artery with the uncovered lesion of the Talent stent graft (Medtronic, Inc, Minneapolis, Minn). Our option for the management of the left subclavian artery was the branched stent graft. We reported the feasibility of this technique in another article.[3]

We report a case of successful closure of a large PDA by using the Inoue single-branched stent graft. Stent grafting may be an

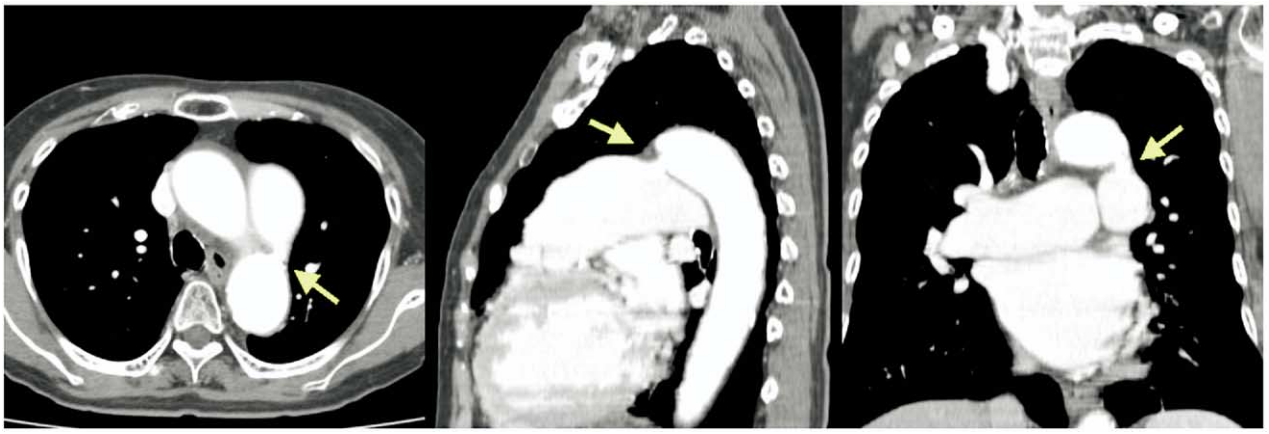

Figure 1. Axial, sagittal, and frontal views of the preoperative computed tomographic scans demonstrating the PDA *(arrow)*.

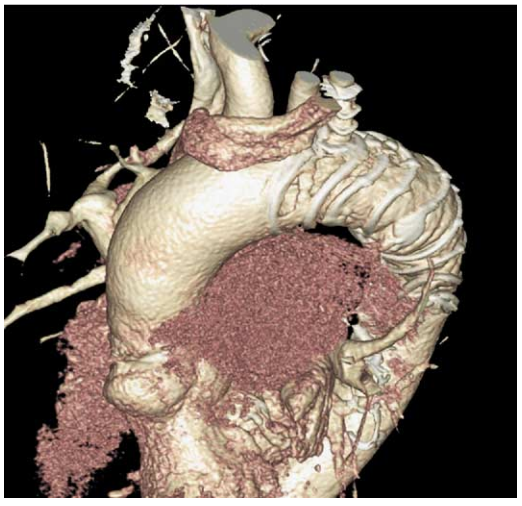

Figure 2. Three-dimensional reconstruction of the computed tomographic scan demonstrating satisfactory stent-graft position and a patent left subclavian artery.

attractive option for closing large PDAs, especially when the ADO device is not applicable.

References

1. Wang JK, Liau CS, Huang JJ, Hsu KL, Lo PH, Hung JS, et al. Transcatheter closure of patent ductus arteriosus using Gianturco coils in adolescents and adults. *Catheter Cardiovasc Interv.* 2002; 55:513-8.
2. Pass RH, Hijazi Z, Hsu DT, Lewis V, Hellenbrand WE. Multicenter USA Amplatzer patent ductus arteriosus occlusion device trial: initial and one-year results. *J Am Coll Cardiol.* 2004;44:513-9.
3. Saito N, Kimura T, Odashiro K, Toma M, Nobuyoshi M, Ueno K, et al. Feasibility of the Inoue single-branched stent-graft implantation for thoracic aortic aneurysm or dissection involving the left subclavian artery: short- to medium-term results in 17 patients. *J Vasc Surg.* 2005;41:206-12; discussion 212.
4. Spies C, Ujivari F, Schrader R. Transcatheter closure of a 22 mm patent ductus arteriosus with an Amplatzer atrial septal occluder. *Catheter Cardiovasc Interv.* 2005;64:352-5.
5. Rehders TC, Petzsch M, Ince H, Kische S, Korber T, Koschyk DH, et al. Intentional occlusion of the left subclavian artery during stent-graft implantation in the thoracic aorta: risk and relevance. *J Endovasc Ther.* 2004;11:659-66.
6. Ozmen J, Granger EK, Robinson D, White GH, Wilson M. Operation for adult patent ductus arteriosus using an aortic stent-graft technique. *Heart Lung Circ.* 2005;14:54-7.